Thoracic Aortic Dissection and Mycotic Pseudoaneurysm in the Setting of an Unstable Upper Thoracic Type B2 Fracture

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Global Spine J 2012;2:175–182.

Abstract

Thoracic type B2 fractures are high-energy injuries. It is crucial to maintain a high index of suspicion for concomitant visceral injuries. A 33-year-old man presented after a motor vehicle accident with a T4 type B2.3 fracture with an associated sternum fracture. He was treated with a T4 corpectomy and an expandable titanium cage and lateral plate construct at T3–T5. Two months later he developed focal kyphosis and loosening of his screws. This was addressed with an instrumented posterior fusion from T1 to T8 complicated by a wound infection, pneumonia, and fungal esophagitis requiring several debridements and vacuum assisted closure therapy. Worsening back pain prompted a thoracic computed tomography scan, revealing a dissecting thoracic-aortic aneurysm, which was treated with an endovascular stent graft. Few months later, he presented with fevers, chills, and hemoptysis secondary to *Staphylococcus aureus* bacteremia, endovascular leak, and T3–T5 osteomyelitis. He was transferred to our institution and restented by the cardiothoracic service. Subsequently, he underwent a thoracotomy, evacuation of infected aneurysmal hematoma with removal of instrumentation. A revision corpectomy with iliac crest autograft reconstruction was performed without complications. The patient's infection and thoracic pain resolved. However, there was a significant delay in treatment, resulting in substantial morbidity. Patients with thoracic type B2 fractures require careful evaluation for concomitant aortic and visceral injuries. Missed associated injuries result in increased morbidity and mortality.

Keywords
- thoracic fracture
- type B2 injury
- B2 fracture
- B2.3 injury
- mycotic pseudoaneurysm
- aortic dissection

Traumatic aortic injury can be a major cause of mortality and morbidity in patients with blunt trauma to the thorax. In most clinical series, ~90% of such ruptures occur at the aortic isthmus, just past the takeoff of the left subclavian artery.[1] The occurrence of an aortic injury concomitantly with thoracolumbar spine trauma is rare. Although associated injuries occur in 40 to 50% of thoracolumbar spine fractures, aortic trauma is infrequent.[2,3] Either of these injuries can result in paraplegia and/or hemodynamic instability, making the timely diagnosis of the injury complex a clinical challenge.[4,5] A delay in diagnosing an aortic injury can result in significant morbidity or mortality.

Aortic injuries can also be caused by anterior or posterior spinal instrumentation. Anterior spinal instrumentation has an effective and safe track record since the 1960s. However, some complications have been reported.[6–8] Specifically, major vessel injury and aortic lacerations have been reported with the anterior approach to the spine,[6,9] and this can result

received
September 25, 2011
accepted after revision
March 26, 2012

DOI http://dx.doi.org/10.1055/s-0032-1315452.
ISSN 2192-5682.

in a devastating outcome. Delayed presentation of an aortic dissection has also been reported previously.[10–12] However, this is a very rare occurrence, and its sequelae and treatment are not well documented in the spine literature. To our knowledge, a missed thoracic-aortic dissection in association with a thoracic type B2 fracture has not been addressed in the peer-reviewed medical literature. Thus, the following is a case report detailing the complex postoperative course of a type B2.3 fracture with a missed aortic injury.

Case Report

A healthy 33-year-old man was involved in an unrestrained high-speed motor vehicle accident (MVA) and suffered multiple fractures including a sternum fracture and a type B2.3 fracture of the T4 vertebral body. He had several spine surgeries including an anterior corpectomy with reconstruction and a posterior instrumented fusion, and later a descending thoracic stent graft before he was finally diagnosed with a contained infected rupture of his descending aorta. During treatment, he experienced several hospitalizations, interventions, and complications. The following report explains the patient's initial accident and his subsequent episodes, including operative treatments, complications, and postoperative outcome.

Episode 1

In August 2008, the patient sustained a T4 type B2.3 fracture and a sternum fracture in an MVA (►**Fig. 1**). The initial imaging focused on his spinal injuries and did not include contrast-enhanced angiography or complete thoracic studies. Due to the unstable fracture pattern and possible neurological demise, a T4 corpectomy with T3–5 interbody fusion with an expandable titanium cage and autogenous bone graft and side plate construct was performed (►**Fig. 2**). There were no intraoperative complications. At 2-month follow-up, his radiographs revealed focal kyphosis with backing out of his screws (►**Fig. 3**). Noncontrast computed tomography (CT) of the chest and thoracic spine was performed and the aortic lesion was not identified. The operative surgeon elected not to remove the anterior construct, but stabilized the patient posteriorly with segmental pedicle-screw instrumentation and fusion from T1 to T8 (►**Fig. 4**). This procedure was complicated by a deep wound infection, pneumonia, and fungal esophagitis; requiring multiple debridements, vacuum assisted closure therapy, and prolonged intravenous antibiotics/antifungals. He remained neurologically intact and his surgical wounds healed. Follow-up radiographs revealed a stable alignment without any significant change in construct positioning.

Episode 2

In February 2009, the patient fell on ice and his back pain progressed. An intravenous contrast thoracic CT scan finally revealed the descending thoracic-aortic aneurysm with dissection. This was treated with an endovascular stent graft. Subsequently, in April 2009 the patient reappeared at another hospital with fevers, chills, and hemoptysis. He had developed staphylococcal bacteremia and an endovascular leak in the proximal descending aorta. Next, he was transferred to Cleveland Clinic Intensive Care Unit with severe hypertension and unremitting back pain. He was stabilized hemodynamically and underwent a repeat CT angiography, revealing an infected pseudarthrosis at the T4 corpectomy and displacement of anterior screws causing a proximal type I endoleak with a contained aortic rupture (►**Fig. 5**). The cardiothoracic service initially managed his endoleak with proximal extension stent grafting of the distal aortic arch and descending thoracic aorta. After ruling out aortic fistulas and other causes of mediastinal infections, he was taken to the operating room on April 15, 2009, for persistent bacteremia where a thoracotomy was performed by the cardiothoracic surgeon (E.R.). The proximal descending pseudoaneurysm was evacuated of the infected clot, which had entirely enveloped the loose anterior-inferior screw from the lateral plate. Sequentially, the grossly loose anterior spinal construct was explanted, and irrigation and debridement of the osteomyelitis performed. A revision T4 corpectomy was executed followed by reconstruction with tricortical iliac crest autograft. Anterior reinstrumentation was not performed based on the CT-confirmed posterior arthrodesis and the ventral infection. Next, a bovine pericardium graft was oversewn to the aortic stent graft, the space was filled with concentrated vancomycin paste, and the thoracic cavity was closed over chest tubes (►**Fig. 6**). The patient was placed on appropriate antibiotics and later antifungals after final cultures revealed mycotic growth from his pseudoaneurysm. Subsequently, he remained neurologically intact and continued to make good functional improvement with physical therapy. At his last visit, the patient's upper back pain was significantly reduced and he was ambulating without assistance.

Discussion

Traumatic aortic rupture in addition to a thoracic spine fracture is an extremely rare but serious injury. Schmidt et al reported a 15-year experience with 80 patients treated for a traumatic aortic tear. Only four patients had a concomitant spine fracture.[13] Similarly, Stambough et al reported $<1\%$ incidence of operatively treated spinal fractures to have a significant associated aortic trauma.[14] The rarity of this association may be in part due to the notable on-the-scene mortality rate secondary to high-energy blunt aortic trauma.

In survivors, the prompt diagnosis and therapy of these combined injuries is crucial. A thoracic fracture can often be diagnosed with routine X-rays or a CT scan. Currently, CT scans are routinely performed for traumas and can provide the information needed to understand the fracture and diagnose an aortic injury. Biquet et al reported that CT scans can identify aortic trauma with a sensitivity of 92% and a specificity of a 100%.[15] However, the diagnosis of an aortic dissection relies strictly on high clinical suspicion, and the accuracy of CT depends on the use of intravenous contrast angiography timed for the arterial phase.

The combination of aortic and spinal trauma can be confusing in that both injuries can contribute to paraplegia

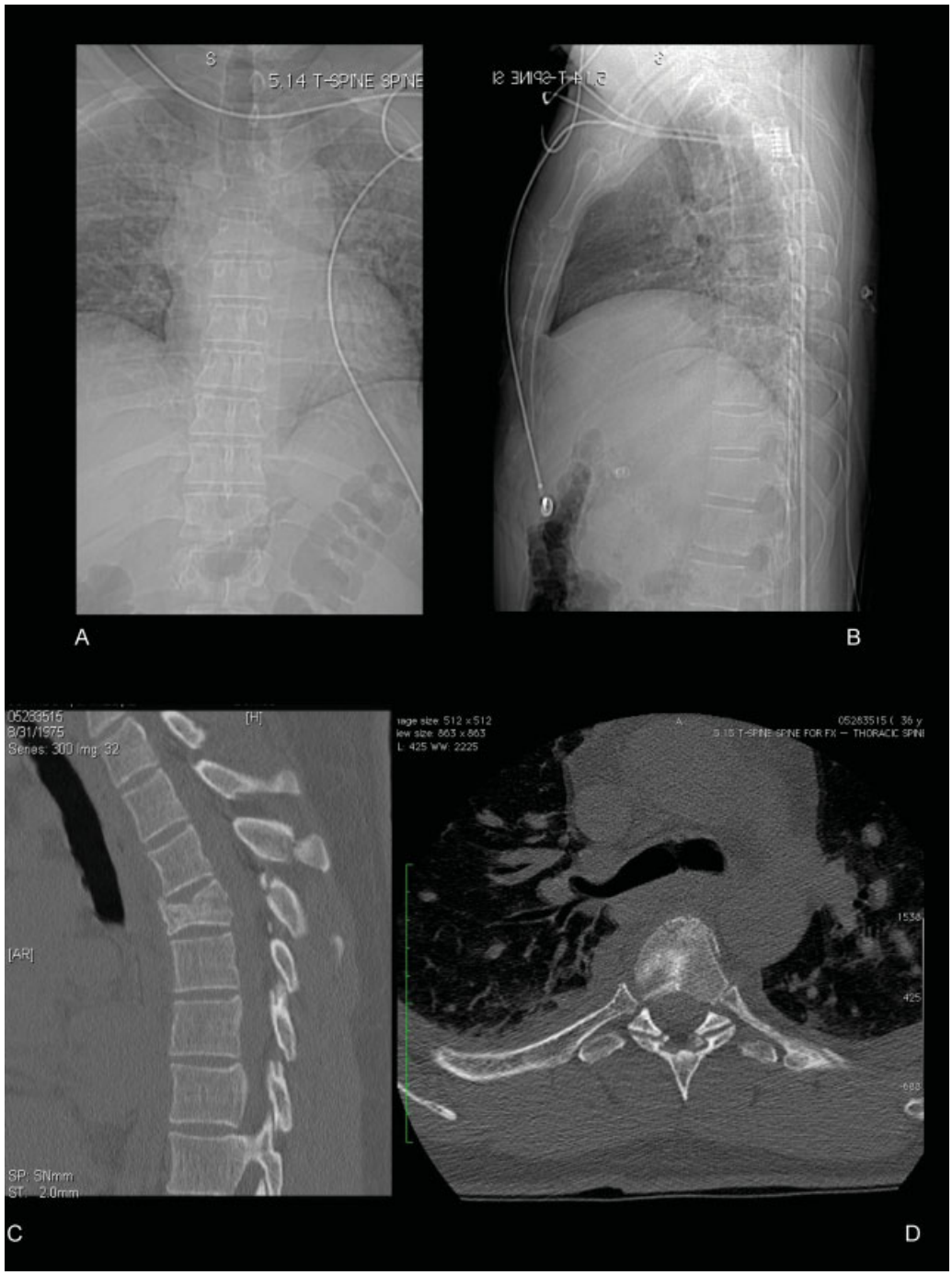

Figure 1 Injury films with scout anteroposterior (A), lateral (B), and sagittal computed tomography (CT) (C), and axial CT scan (D) images show a T-4 type B2.3 fracture.

and hypotension.[4,5,14] It is the clinician's responsibility to specifically rule out the presence of this injury pattern. A thorough lower-extremity vascular examination and a careful evaluation of chest X-rays and CT scans, for mediastinal or aortic widening, are critical. The diagnosis must be followed by an expedient management plan. An unstable vascular injury takes precedence over the spinal injury.[16] Only after appropriate assessment and repair of the aortic injury should the spinal fracture be stabilized. In recent years, the preferred approach to treat traumatic aortic dissection has been endovascular stent grafting with excellent results.[17]

This patient was diagnosed with a dissecting aortic aneurysm approximately 6 months after initial presentation and about 4 months after posterior spinal fixation for progressive kyphosis. This opens up the possibility that surgery, either the anterior or the subsequent posterior instrumentation, may have caused the aortic injury. However, neither the operative records nor the operative films reveal aortic penetration. To

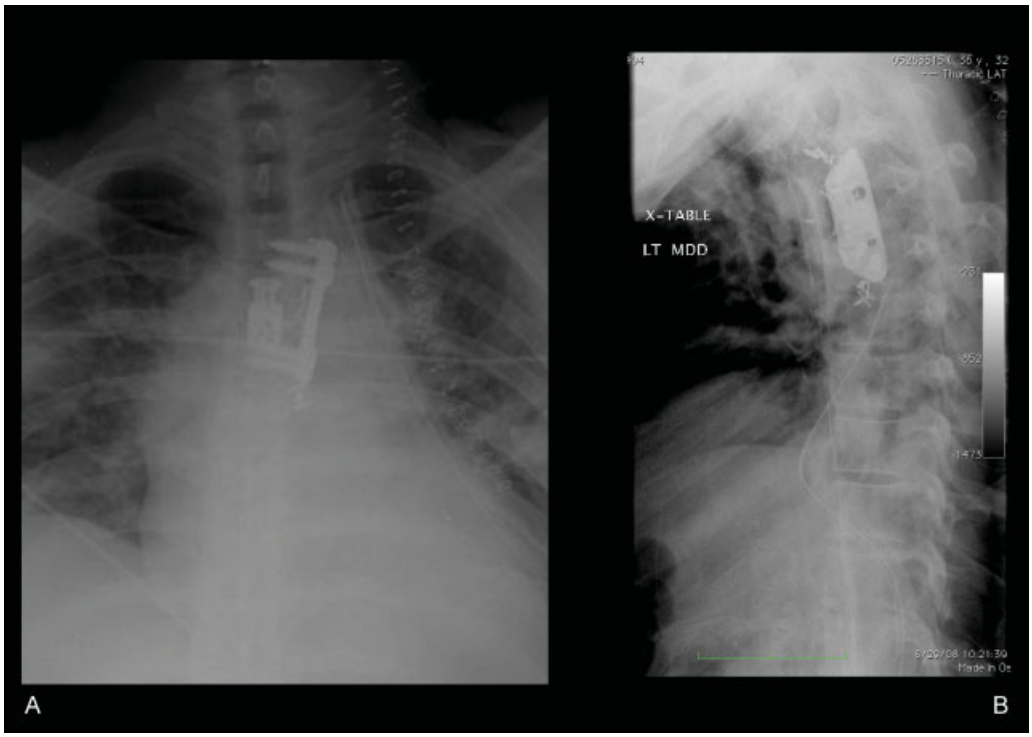

Figure 2 Postoperative anteroposterior (A) and lateral (B) X-rays after anterior corpectomy and instrumentation reveal hardware prominence with compromised cranial fixation at T3 and T5 superior endplate violation with cage reconstruction.

clarify the root cause of the aortic injury, we obtained a comprehensive record from the initial treating hospitals. A retrospective review was performed of the plain films, CT scans, and MRIs. This review was educational and delineated some key conceptual flaws in the approach to this injury. First, the primary injury was a three-column T4 type B2.3 fracture without significant canal compromise with an associated sternum fracture. This unstable injury is prone to failure if solely treated anteriorly and is best treated with a posterior stabilization approach (►**Figs. 1**, **2**, **3**, **4**). It is critical to restore the posterior tension band to prevent progressive kyphosis and deformity as witnessed in this case (►**Fig. 3**). Furthermore, an

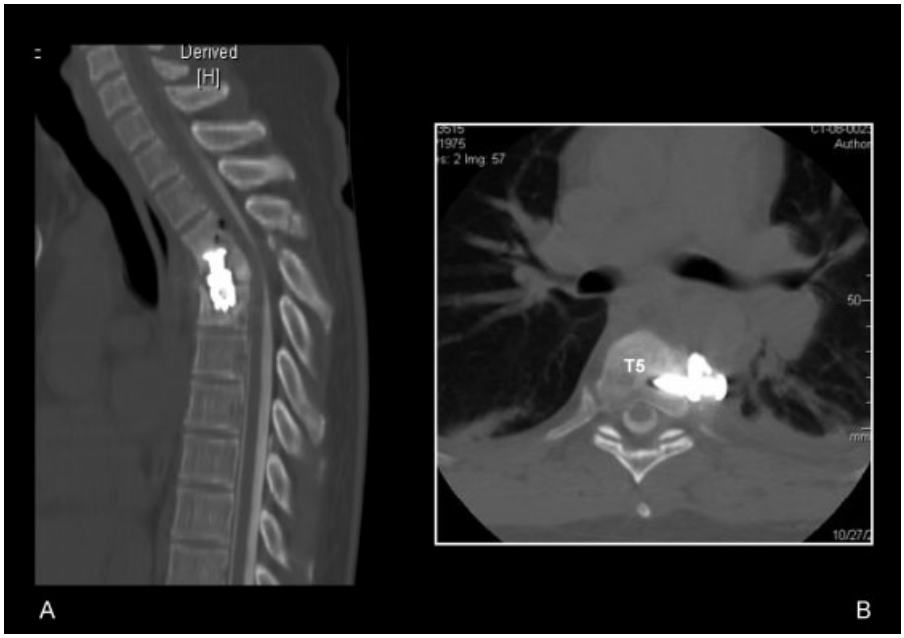

Figure 3 Noncontrast computed tomography-myelogram of the thoracic spine reveal failed anterior instrumentation, cage subsidence, progression of kyphosis (A) and backed-out screw juxtaposed on the proximal descending aorta (B).

Figure 4 Right (A) and left (B) posterior pedicle screw fixation at thoracic 1, 2, 3, 6, 7, 8. Coronal (C) and axial computed tomography (D) scan images reveal the proximity of the posterior construct to the preexisting anterior instrumentation.

anterior approach at this level is challenging both in terms of obtaining exposure and appropriate placement of instrumentation (►**Fig. 2**). If an anterior approach is utilized at a high thoracic level, it is often impossible to maintain a sufficient cushion between the aorta and the hardware (►**Figs. 2**, **3**). This may necessitate not only a frequent and close follow-up, but a removal of instrumentation after fusion is achieved.

The second lesson is maintaining a high index of suspicion for visceral injury with a three-column thoracic fracture, especially if anterior instrumentation is being utilized. When the patient had developed initial signs of hardware failure and kyphosis, the anterior instrumentation should have been removed and the proximal aorta inspected for dissection. The relevant images from that hospitalization

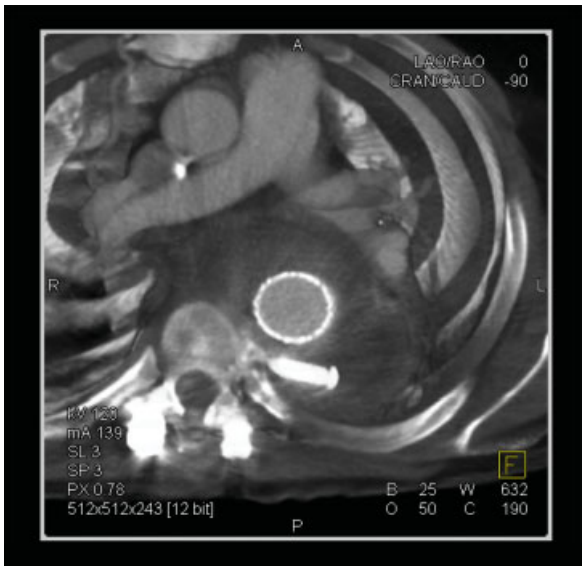

Figure 5 Eight months after injury: 3-D computed tomography scan shows a loose screw juxtaposed to the descending aorta with an aneurysm.

revealed backed out screws with an imminent threat to the pulsating aorta (►**Fig. 3**).

Aortic injuries range from minor intimal tears and contained lacerations to uncontained full-thickness ruptures. Clinically, these patients can be subdivided into three types of presentations: (1) hemodynamically unstable, (2) hemodynamically stable yet symptomatic, and (3) asymptomatic and hemodynamically stable. Although the first group requires emergent operative intervention, the last group can often be treated by simple observation.[18] Appropriate and timely diagnosis must be made to maintain a close follow-up as it is possible for the stable patient to develop further aortic degeneration and pseudoaneurysm. This case report underscores the point of maintaining a high index of suspicion for a concomitant aortic injury with a thoracic type B2 fracture, especially after an anterior stabilization procedure. A close clinical and radiographic follow-up with CT scans of the chest would allow the appropriate level of surveillance. However, a high clinical suspicion with an equivocal chest CT scan should prompt the physician to pursue an aortic angiogram.

Conclusion

Although the incidence of a traumatic aortic dissection in the presence of a spinal fracture is extremely rare, patients with thoracic type B2 fractures, with and without sternum fractures, must be carefully evaluated for concomitant visceral injuries. The clinician should conduct a thorough preoperative evaluation, be equally diligent intraoperatively to note disruption of the surrounding tissues, and be prepared to deal with thoracic-aortic dissections at the same setting. Failure of prompt diagnosis and management of such injuries exposes the patient to significant morbidity and even mortality.

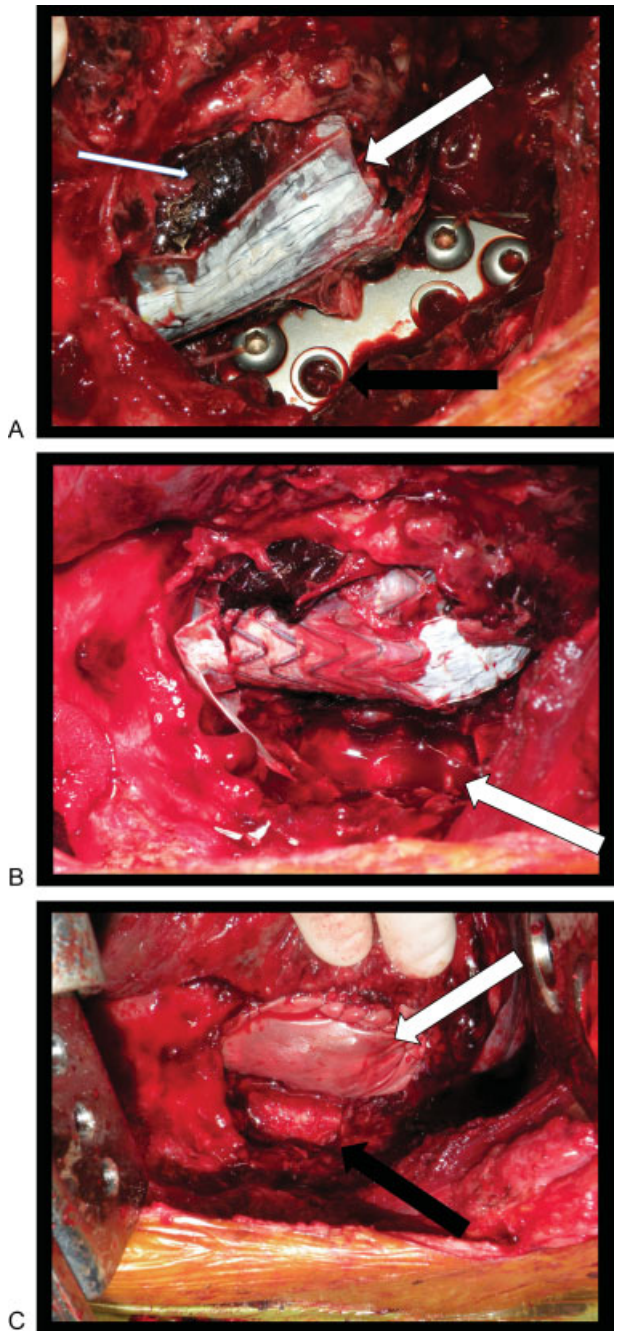

Figure 6 (A) Intraoperative picture reveals complete degradation of the native aortic wall and endovascular stent grafting (thick white arrow). Remnant of infected pseudoaneurysmal clot (thin white arrow), and evacuation of infected clot containing the loose inferior screw (solid black arrow). (B) Intraoperative picture showing explantation of the cage and plate construct. (C) Intraoperative picture reveals tricortical iliac-crest autograft reconstruction (black arrow) and a bovine pericardium closure (white arrow) of the aortic wall defect to cover the endovascular aortic stent graft.

Disclosures
Saad B. Chaudhary, None
Eric Roselli, None
Michael Steinmetz, Biomet Spine
Thomas E. Mroz: Consulting: Globus Medical; Stock Options: PearlDiver, Inc.; Speaking Honoraria: AO Spine

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